



# A METHOD OF MANUFACTURING A SPEAKER USING AN INSERTION JIG

## BACKGROUND OF THE INVENTION

### **(1) Field of the Invention**

5 The present invention relates to a voice coil insertion jig used in manufacturing speakers that are incorporated in various acoustic appliances, a method of manufacturing a speaker using this jig, and a speaker manufactured by using this jig.

### **(2) Description of Related Art**

10 The prior art is explained by referring to Figures 3 to 5. Figure 3 is a sectional view of a speaker, Figure 4 is a perspective exploded view of a voice coil assembling jig used when assembling the speaker, and Figure 5 is a sectional view illustrating the assembling process of the voice coil.

15 A structure of a speaker is described in Figure 3. Magnetic circuit 1 is composed of a lower plate 1a having a center pole 1b, a magnet 1c coupled on a lower plate 1a, and an upper plate 1d coupled on magnet 1c. Magnetic circuit 1 has a magnetic gap 1e between upper plate 1d and center pole 1b. A frame 2 is coupled to upper plate 1d. A diaphragm 3 is coupled to frame 2 by way of an edge 3a formed on an outer circumference of diaphragm 3. A voice coil 4 is composed of a 20 coil 4a and a bobbin 4b. Coil 4a is inserted in magnetic gap 1e, and an internal circumference of diaphragm 3 is coupled to a specified position of bobbin 4b. An outer circumference of damper 5 is coupled to frame 4, and an inner circumference of damper 5 is coupled to bobbin 4b. In this constitution, voice coil 4 is supported movably up and down.

25 In the manufacturing process of such a speaker, what requires the highest

precision is the inserting process of voice coil 4 into magnetic gap 1e.

A conventional voice coil insertion jig disclosed in Japanese Laid-open Utility Model No. 57-160292 is explained by referring to Figures 4 and 5. The conventional voice coil insertion jig is composed of a jig main body 11, a gauge tube 12, a slit 13, and a spring 14.

Spring 14 is assembled into an inside of jig main body 11, and generates a force for opening slit 13. The insertion jig is inserted into bobbin 4b while closing slit 13, and after positioning, voice coil 4 is fixed by the pressure of spring 14. Together with the jig, voice coil 4 is inserted into center pole 1b of magnetic circuit 1. That is, voice coil 4 is inserted into magnetic gap 1e. At this time, depending on the material thickness of gauge tube 12, the position of voice coil 4 in the radial direction is defined. In this state, frame 2 is adhered and coupled to magnetic circuit 1. (Frame 2 may be first adhered and coupled to magnetic circuit 1.) After adhering damper 5 and diaphragm 3 to frame 2 and bobbin 4b, the insertion jig is pulled out of the speaker. Finally, dust cap 6 is adhered and coupled to diaphragm 3, and the speaker is manufactured.

Thus, in the speaker manufacturing process, the voice coil insertion jig is required to have a high precision for positioning voice coil 4.

As the appliance is reduced in size recently, a speaker of small size and high efficiency is demanded. For this purpose, magnetic gap 1e is required to be much narrower.

#### **BRIEF SUMMARY OF THE INVENTION**

It is hence an object of the invention to solve the above problem, and present a voice coil insertion jig for realizing a speaker of high performance with a narrower

magnetic gap by enhancing the positioning precision of the voice coil in the magnetic gap, a method of manufacturing a speaker using the jig , and a speaker manufactured by using the jig.

In one aspect of the invention, a voice coil insertion jig includes

5        a base ,a hollow cylindrical insertion part provided integrally in a lower part of the base, and a plurality of moving pieces provided integrally in an upper part of the base, the outside diameter being formed the plurality of moving pieces being larger than the outside diameter of the insertion part. The voice coil insertion jig also includes

10      a central boss, provided above a center of the base, that is separate from the moving pieces, such that the plurality of moving pieces elastically contacts and holds the voice coil.

In another aspect of the invention, a method of manufacturing a speaker using a voice coil insertion jig includes deforming a plurality of moving pieces elastically to a central boss side, and inserting the moving pieces into a voice coil, restoring the elastic deformation, and holding the voice coil in a voice coil insertion jig, inserting the voice coil insertion jig into a magnetic gap forming a magnetic circuit, and adhering an inner circumference of a diaphragm to the voice coil, and adhering an outer circumference of the diaphragm to a frame. The method also includes

15      deforming the plurality of moving pieces elastically to the central boss side, and extracting the voice coil insertion jig from the magnetic gap.

Thus, the speaker of the invention is manufactured using the voice coil insertion jig composed as described above.

Figure 1A is a top view of a preferred embodiment of voice coil insertion jig of the invention.

Figure 1B is a sectional view along section line A-O-B of Figure 1A.

Figure 1C is a bottom view of the voice coil insertion jig.

5 Figure 2A is a top view of another preferred embodiment of the voice coil insertion jig of the invention.

Figure 2B is a sectional view along section line A-O-B of Figure 2A.

Figure 2C is a bottom view of the voice coil insertion jig shown in Figure 2A.

Figure 3 is a side sectional view of a speaker.

10 Figure 4 is a perspective exploded view of voice coil assembling jig used in assembling of the speaker.

Figure 5 is a sectional view illustrating the assembling process of the voice coil.

15 **DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS**

Preferred embodiments of a voice coil insertion jig of the invention are described below with reference to Figures 1A through 2C and Figure 3. It should be understood that parts described in the preferred embodiments that are also included in the description of the prior art are identified with same reference numerals, and 20 the explanation is omitted.

(Preferred embodiment 1)

Figure 1A is a top view of a preferred embodiment of a voice coil insertion jig. Figure 1B is a sectional view along section line A-O-B side of Figure 1A. Figure 1C is a bottom view of the voice coil insertion jig.

25 A voice coil insertion jig 20 is composed of a base 20a, a hollow cylindrical

insertion part 20b provided in a lower part of base 20a, a plurality of moving pieces 20c, and a central boss 20d. The plurality of moving pieces 20c are provided integrally in an upper part of base 20a, are separate from each other, and each include an outer circumference formed as an arc of nearly the same circumference.

- 5    A diameter in upper parts of each of the plurality of moving pieces 20c is constant, and the diameter is smaller in lower parts of each of the plurality of moving pieces 20 because a slope is provided. Central boss 20d disposed apart from moving pieces 20c is formed so as to extend upward from a center of base 20a. An outer circumference of central boss 20d is opposite to each of the plurality of moving  
10 pieces 20c across a specified gap.

Each of moving piece 20c has a horizontal slit 20e at a lower outer side thereof. Moving pieces 20c are formed integrally in base 20a and are separated from each other by a vertical slit 20f.

- 15    Slit 20f is formed for reducing an outside diameter formed by moving pieces 20c when inserting voice coil insertion jig 20 into voice coil 4, or when extracting voice coil insertion jig 20 from voice coil 4. Therefore, the width of slit 20f is not particularly defined as far as moving pieces 20c can be inclined for an inserting and extracting process (it is further preferred to set the slit width to such an extent that moving pieces 20c may not be inclined over the limit of elasticity for the sake of the  
20 inserting and extracting process).

- 25    A diameter  $d_1$  of an outer circumference of base 20a and of insertion part 20b, and a diameter  $d_2$  formed by upper parts of moving pieces 20c in an ordinary state are such that  $d_2 > d_1$ . A diameter of an outer circumference formed by lowest end parts of outer sides of moving pieces 20c is set nearly at  $d_1$ , and  $d_1$  is set to be equal to an inner circumference of voice coil 4. As shown in Figure 1A, moving pieces

20c include an inner wall side that is polygonal (tetragonal in the preferred embodiment) such that an angle is provided to facilitate defining vertical slit 20f. A width of vertical slit 20f represents an interval of mutually opposing sides of moving pieces 20c.

5       Central boss 20d is formed longer than moving pieces 20c, and is used as a knob in the working process.

10      Magnetic gap 1e between voice coil 4 and magnetic circuit 1 is assured by the thickness of insertion part 20b. An outer circumference of center pole 1b and an inner circumference of insertion part 20b are nearly equal, and only a slight allowance for insertion during assembling process is provided. Moreover, an interval between the outer circumference of center pole 1b and voice coil 4 is assured by a thickness of insertion part 20b, and hence an interval between upper plate 1d and voice coil 4 is also assured.

A method of assembling a speaker is explained.

15      By pushing moving pieces 20c of voice coil insertion jig 20 to the inner side to deform within an elastic deforming range, voice coil insertion jig 20 is inserted into voice coil 4. After inserting jig 20 up to a specified position, the inward pushing force applied to moving pieces 20c is released. As a result, moving pieces 20c elastically contact with the inner side of voice coil 4 in the restoring process. Thus, 20 voice coil 4 is held in voice coil insertion jig 20.

20      While holding voice coil 4, insertion part 20b is fitted into center pole 1b of magnetic circuit 1, preliminarily adhered and coupled to frame 2, and inserted into magnetic gap 1e.

25      In succession, damper 5 and diaphragm 3 are adhered to frame 2 and coil bobbin 4b as shown in Fig. 3. Then, with moving pieces 20c being pushed to the

central boss side, insertion jig 20 is pulled out. Finally, dust cap 6 is adhered to diaphragm 3.

In this manner, by using voice coil insertion jig 20 of the preferred embodiment, positioning and fixing of voice coil 4, and handling when assembling 5 the speaker can be done easily by using moving pieces 20c and central boss 20d, so that the working efficiency can be enhanced.

Further, since insertion part 20b does not have slit 13 as in the prior art, but is a hollow tube, deformation of voice coil 4 can be prevented.

Moreover, magnetic gap 1e depends only on the thickness of this insertion part 10 20b, so that magnetic gap 1e is assured to remain constant. Hence, magnetic gap 1e can be narrowed, the magnetic efficiency enhanced, and a higher output realized, while the magnetic circuit is reduced in size and the speaker is reduced in weight .

In the preferred embodiment, a speaker having damper 5 is explained, but it can be similarly applied to a speaker without a damper.

15 (Preferred embodiment 2)

An alternate preferred embodiment of the invention is explained by referring to a top view of voice coil insertion jig 20 as shown in Figure 2A, a sectional view along sectional line A-O-B in Figure 2B, and a bottom view of jig 20 as shown in Figure 2C. It should be understood that parts described in the preferred embodiment 20 that are also included in the alternate embodiment are identified with same reference numerals, and the explanation is omitted.

Only different points from the preferred embodiment are described below. A first different point is that center pin 20g is provided in insertion part 20b. Center pin 20g is formed downward in the center of base 20a. In a center of center pole 1b, 25 a center pole hole (not shown) for inserting center pin 20g is formed. In the

manufacturing process, by inserting center pin 20g into the center pole hole , voice coil 4 is positioned.

As a result, in contrast to the preferred embodiment , it is not required to position voice coil 4 by defining the outer circumference of center pole 1b to be 5 substantially the same as the diameter of inner circumference of insertion part 20b. Moreover, by inserting center pin 20g, it is easier to position voice coil 4 than in the preferred embodiment , and voice coil 4 can be positioned without depending on the diameter of center pole 1b. Consequently, jig 20 can be managed easily without preparing insertion jig 20 for the portion of difference in outside diameter of center 10 pole 1b.

### **INDUSTRIAL APPLICABILITY**

As described herein, the invention presents a voice coil insertion jig capable of assembling a speaker at excellent working efficiency and high precision without 15 deforming the voice coil, a manufacturing method using the jig , and a speaker manufactured by this method.